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Abstract

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Phosphine intoxication following oral exposure of horses to aluminum phosphide–treated feed

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Case Description—66 horses were potentially exposed to phosphine (a gas) 14 hours after being fed a pelleted ration treated with aluminum phosphide.

Clinical Findings—28 horses had clinical signs of profuse sweating, tachycardia, tachypnea, pyrexia, ataxia, seizures, and widespread muscle tremors. Clinically relevant laboratory findings included hypoglycemia and high plasma concentrations of lactate and ammonia and activities of γ-glutamyl transpeptidase, aspartate aminotransferase, and alkaline phosphatase. At least 4 horses had signs consistent with hepatic encephalopathy. Necropsy findings included petechial and ecchymotic hemorrhages in multiple organs, widespread vascular congestion, hepatic lipidosis, and neuronal necrosis in the brain. Phosphine was detected in the stomachs of the 3 horses tested.

Treatment and Outcome—On the farm, horses were treated with gastric lavage followed by administration of di-tri-octahedral smectite, atropine, fluids, and sedatives. Six horses were hospitalized, and lactated Ringer's solution and flunixin meglumine were administered IV. Additionally, 10% dextrose, corn syrup, and di-tri-octahedral smectite were administered PO. Twenty-seven horses died within 2 days after exposure. Two survivors (1 without clinical signs of toxicosis) made a complete recovery.

Clinical Relevance—Progression of clinical signs in affected horses in this report was rapid, with few treatment options available, leading to a high case fatality rate. Fumigation with aluminum phosphide is commonly performed to eliminate weevils and other insects from stored grains. When appropriate precautions are used during fumigation, risk to livestock is typically minimal.

CITING ARTICLES

Sarah L. Gray, Justine A. Lee, Lynn R. Hovda, Ahna G. Brutlag. (2011)

Potential zinc phosphide rodenticide toxicosis in dogs: 362 cases (2004–2009). *Journal of the American Veterinary Medical Association* **239**:5, 646-651
Online publication date: 1-Sep-2011.
Abstract | Full Text | PDF (374 KB) | PDF Plus (374 KB)

Full Text PDF (669 KB) PDF Plus (678 KB)

2

javmaNews

public health

AVMA journals > JAVMA News > Phosphine poisoning

June 1, 2010

posted May 19, 2010

Phosphine gas can sicken veterinarians, clinic staff

Rodenticides eaten by animals pose a risk of secondary exposure

Back

IO 23235

Michigan health authorities warned that veterinarians and clinic staff can be sickened while treating patients that have eaten some rodent poisons.

1002
1003

Officials with the state's Department of Community Health issued an alert in April on the basis of incidents at two clinics in 2006 and 2008 in which dogs had eaten zinc phosphide pellets intended to kill gophers or moles. In each incident, multiple veterinary clinic staff members became ill from the release of phosphine gas after the dogs were induced to vomit, said Abby Schwartz, a public health consultant for the department.

Phosphine gas is produced as some pesticides, such as those containing zinc phosphide, react with acid or water in an animal's stomach.

Staff from the two involved clinics in Michigan suffered mild illnesses that included headaches, shortness of breath, nausea, and dizziness, the department statement indicates. Schwartz said both dogs also survived.

But department officials' ongoing concern about the potential for serious illness or death led them to write letters recently to the Michigan VMA and the AVMA as well as develop a fact sheet for pet owners.

Information from the Centers for Disease Control and Prevention's Agency for Toxic Substances and Disease Registry states that phosphine is colorless, flammable, and explosive at ambient temperature and has the odor of garlic or decaying fish. In humans, symptoms of acute phosphine intoxication include diaphragm pain, nausea, vomiting, excitement, and a smell of phosphorus on the breath. Exposure to high concentrations can cause weakness, bronchitis, pulmonary edema, shortness of breath, convulsions, and death.

Pulmonary edema, convulsions, and liver injury can appear or remain present days after exposure, agency information states.

Dr. Safdar A. Khan, senior director of toxicology research for the Animal Poison Control Center of the American Society for the Prevention of Cruelty to Animals, said his organization frequently receives calls about dogs eating zinc phosphide-containing pesticides. He noted that dogs have been known to dig up the pesticides after seeing people plant the pellets in their yards.

3

When phosphine poisoning is suspected, ASPCA Animal Poison Control Center staff members recommend that veterinarians induce animals to vomit outside or in rooms with good ventilation, Dr. Khan said. Veterinarians are at risk of secondary exposure and illness even at concentrations at which the garlic-like smell of the gas is not present.

He said that, if an animal vomits inside a building, a fan on the floor combined with open doors and windows can reduce the risk of secondary exposure.

Because phosphine is heavier than air, Michigan health authorities recommend that people avoid lowering their heads toward animals with suspected phosphine poisoning. They also recommend, when such animals vomit outside, that people stand upwind and flush the vomit and surrounding area with water.

The ASPCA's earliest report of a veterinarian becoming ill while treating an animal for zinc phosphide poisoning is from 1994, when an attending veterinarian present during nasogastric intubation of a horse began experiencing neurologic symptoms, Dr. Khan said. A report about the exposure published in a 1996 edition of the Equine Veterinary Journal states that the veterinarian was hospitalized but recovered fully after suffering from symptoms including dizziness, weakness, and tremors.

A scientific report in the Feb. 15 issue of JAVMA describes the more recent phosphine-related deaths of 27 out of 66 horses fed a ration treated with aluminum phosphide, which was intended to kill weevils. Two of about 30 people treating the horses sought hospital treatment for mild dehydration and headache, but the report states that it is unclear what importance those illnesses had, as neither individual had close contact with the gastric contents of treated horses.

The AVMA has information about phosphine and links to additional sources at www.avma.org. Click on "Public Health," then on "Phosphine Gas," and then on "Phosphine product precautions." The CDC also has information on the substance at www.atsdr.cdc.gov/MHMI/mmg177.html.

—GREG CIMA

Return to top

4

Public Health

Phosphine product precautions

In April 2010, the Michigan Department of Community Health[1] notified the AVMA of two situations where veterinary personnel were affected during the treatment of dogs that had ingested zinc phosphide rodenticide pellets; it is suspected that human exposure resulted from the release of phosphine gas into the examination rooms when the dogs were induced to vomit. Manuscripts in the *Equine Veterinary Journal*[2] in 1996 and in the *Journal of the American Veterinary Medical Association*[3] in 2010 reported that several individuals became ill associated with the veterinary treatment of horses with phosphine poisoning.

Zinc phosphide is a common component of rodenticides for home and commercial use, and aluminum phosphide is commonly used in agriculture as an insecticide for the fumigation of grains and animal feed. Both products liberate phosphine gas, which is highly toxic to animals and people.

Animals can be exposed to the toxic effects of zinc phosphide when they eat rodent bait containing the product. Trade names of zinc phosphide-containing rodenticides include Arrex, Denkarin Grains, Gopha-Rid, Phosvin, Pollux, Ridall, Ratol, Rodenticide AG, Zinc-Tox and ZP. Horses and other livestock can be exposed to aluminum phosphide if they are fed animal feeds that have not been appropriately treated or withheld prior to distribution. With proper application and appropriate withholding periods (the time between treatment with the aluminum phosphide and packaging and distribution of the animal feed), the risk of phosphine gas exposure to people or to animals (other than the pests in the fumigated feed) is minimal.

Clinical signs of phosphine poisoning in animals can occur within minutes to hours of ingestion of a toxic dose, and include loss of appetite, nausea, vomiting (which may be bloody), abdominal pain, diarrhea, lethargy, incoordination, convulsions, paralysis, coma and death. As little as one tablespoon (15 ml) of zinc phosphide pellets can produce toxicity in a 10 kg (22 lb.) dog.[4] Once clinical signs of poisoning are observed, the prognosis is guarded at best. Clinical signs of liver or kidney injury can occur 48-72 hours after exposure to the toxin.[4]

Symptoms of phosphine intoxication in people include headaches, shortness of breath, nausea, vomiting, and dizziness. More severe symptoms, including gastrointestinal and respiratory distress, convulsions and death, can occur with severe phosphine poisoning. Veterinarians, veterinary staff and animal owners who handle animals with phosphine poisoning can also be affected and sickened by phosphine gas.

Guidelines for veterinarians:

- Although phosphine-containing baits may have fishy or garlic odors, do not rely on the presence of these odors for suspicion or confirmation of phosphine poisoning. These odors may not be detectable at hazardous concentrations of the gas.
- Personnel should remain upwind and above animal level to reduce their exposure to phosphine gas.
- After the animal has vomited, move it away from the area immediately and flush the area with copious amounts of water (while remaining upwind). If treating livestock by passing a stomach tube, drain the contents into a bucket (instead of on the barn or stall floor) and immediately remove the bucket and contents from the immediate area. Dump the bucket onto grass or down a sewer drain and rinse the area with copious amounts of water.
- Phosphine gas is heavier than air and will sink toward the ground. Remain above ground level and ventilate the area with fans placed at ground level.
- If the animal vomits in an enclosed area, evacuate the area and contact your local fire department. If practical, open windows and doors and place a fan at ground level to evacuate the gas away from people and animals.
- If personnel are exposed to vomitus or gastric contents containing phosphine gas, they should immediately seek medical attention if they are experiencing symptoms.

Guidelines for Pet Owners:

- If your pet has eaten (or you suspect it has eaten) a rodenticide or pesticide of any type, immediately contact your veterinarian or an animal poison control center. Provide them with as much information as possible about the product.
  - ASPCA Animal Poison Control Center: 1-888-426-4435 (a consultation fee may apply)
- If you are instructed to make your pet vomit, take it outdoors to vomit – preferably on a grassy area or near a drain. Stay upwind of the animal and avoid kneeling or lowering yourself to its level

5

(phosphine gas is heavier than air and will be in higher concentrations closer to the ground). Once it has vomited, move all people and the pet away from the area and flush the area with copious amounts of water. If available, place a fan at ground level and evacuate the gases away from people and animals.

- If your pet has been poisoned by a phosphine product and it vomits indoors, evacuate the area and call 911. If you or anyone else in the immediate area are experiencing headache, nausea, stomach pain, diarrhea, vomiting, difficulty breathing, chest pain, dizziness, or staggering, seek immediate medical attention.
- Always store and use rodent baits and other potentially toxic products out of reach of children and animals.
    - For more information about household hazards, view our brochure.

Additional Resources:

Michigan Department of Community Health's page about phosphine intoxication (PDF)

ASPCA Animal Poison Control Center
When the Mouse is Away, Your Cat or Dog May Play: Rat and Mouse Poisons Could Also Harm Pets (2006)

Agency for Toxic Substances and Disease Registry
ToxFAQs for Phosphine

Environmental Protection Agency
Expanding Use Restrictions to Reduce Risks of Aluminum and Magnesium Phosphide
Phosphine hazard summary

Occupational Safety and Health Administration (OSHA)
Health hazard information – grain fumigant

1. Letter from the State of Michigan Department of Community Health, dated April 5, 2010, regarding the exposure of veterinary personnel to phosphine gas during the treatment of dogs with zinc phosphide poisoning. Available at http://www.avma.org/public_health/phosphine_gas/zinc_phosphide_letterAVMA1.pdf.
2. Drolet R, Laverty S, Braselton WE et al. Zinc phosphide poisoning in a horse. *Eq Vet J* 1996; 28: 161-162.
3. Easterwood L, Chaffin MK, Marsh PS et al. Phosphine intoxication following oral exposure of horses to aluminum phosphide-treated feed. *J Amer Vet Med Assn* 2010; 236: 446-450. Available at http://avmajournals.avma.org/doi/pdf/10.2460/javma.236.4.446 (free for members, available for a fee to non-members)
4. Knight MW. Zinc Phosphide Intoxication. In: Cote E, Ed. *Clinical Veterinary Advisor: Dogs and Cats*. St. Louis: Mosby Elsevier, 2007, 1170-1171.

6

RE: Incidents with phosphine gas in domestic animals sickening human beings like veterinarians

Eisemann, John D (APHIS) to: Norman Spurling, Brian Montague 09/01/2011 03:00 PM

Cc: Nicholas Mastrota, Kit Farwell, Steve Robbins, Anne Overstreet, Frank Davido

Thank you Norm. I will take a look at the links you sent.

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-----Original Message-----
From: Spurling.Norman@epamail.epa.gov [mailto:Spurling.Norman@epamail.epa.gov]
Sent: Thursday, September 01, 2011 11:14 AM
To: Montague.Brian@epamail.epa.gov
Cc: Mastrota.Nicholas@epamail.epa.gov; Farwell.Kit@epamail.epa.gov; Eisemann, John D (APHIS); Robbins.Steve@epamail.epa.gov; overstreet.anne@epamail.epa.gov; Davido.Frank@epamail.epa.gov
Subject: Re: Incidents with phosphine gas in domestic animals sickening human beings like veterinarians

Brian,
I checked the Incident Data System and in the individual reports area found nothing that seemed to fit this topic. I also did a search through the aggregate summary data where most of the domestic animal incidents are located, but their package descriptions don't allow pinpointing cases of this sort. That doesn't mean that there are no cases--only that we can't retrieve them by these words in the package descriptions. I was on the lookout for human attributes as well as dogs or pets in the wording for cases on either zinc phosphide, aluminum phosphide or phosphine.

I then went on the web and quickly found
http://www.avma.org/onlnews/javma/jun10/100601ff_pf.asp

http://www.avma.org/public_health/phosphine_gas/default.asp

http://avmajournals.avma.org/doi/abs/10.2460/javma.236.4.446?journalCode=javma

http://www.villagevetcanastota.com/site/view/180183_ZincPhosphidePoisoning.pml

Apparently, the Journal of the Am. Vet. Medical Association, Vol 236, 2010, page 1161 had a warning that phosphine could sicken vets and clinic staff. It was indexed under aluminum phosphide.
http://www.avma.org/journals/javma/javma_index_v236.pdf

Frank Davido's NPIC data might provide more information on this type of cases.

Abby Schwartz of the Michigan Dept. of Community Health compiles their state annual report on pesticide illnesses and this one includes brief summary info on these cases:
http://www.michigan.gov/documents/mdch/Pesticides_Annual_report_2008_304016_7.pdf

Hope that helps some.

Norman Spurling
6(a)(2) Coordination and Analysis Team Leader OPP/ITRMD/ISB

7

703-305-5835

From: Brian Montague/DC/USEPA/US
To: Norman Spurling/DC/USEPA/US@EPA
Cc: Nicholas Mastrota/DC/USEPA/US@EPA, eisemann.john@aphis.usda.gov
Date: 09/01/2011 08:38 AM
Subject: Incidents with phosphine gas

Hi Norm,

I'm wondering if you have been getting anything in on this type of incident. HED would certainly be interested from a worker exposure standpoint if this is substantiated.

Brian

----- Forwarded by Brian Montague/DC/USEPA/US on 09/01/2011 08:35 AM -----

From: "Eisemann, John D (APHIS)" <John.D.Eisemann@aphis.usda.gov>
To: Brian Montague/DC/USEPA/US@EPA, Nicholas Mastrota/DC/USEPA/US@EPA
Date: 08/31/2011 05:01 PM
Subject: search of the EIIS or 6a2 databases

Brian and Nick: Are either of you still involved in maintaining the EIIS database? Do you have access to the 6a2 report database?

I have heard that there are a couple of veterinarians writing a paper on veterinarians being exposed to phosphine gas when examining dogs suspected of zinc phosphide exposure. They are claiming it is a case of secondary poisoning. Phosphine doesn't accumulate in tissues, so I doubt it is secondary poisoning. However, it is not unreasonable that there could be undigested bait in a dogs stomach. Maybe vets are being exposed when the dog burps? I am interested in seeing what EPA is seeing in terms of adverse incidents. I haven't heard about any ZP dog incidents in quite some time.

Would you be able to provide search results from either the EIIS or 6a2 databases? I might contact the ASPCA Poison Control Center to see what they have in their database.

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Department of
Community Health

The Michigan Department of Community Health has become aware of two situations where veterinary clinic staff became sick while treating dogs that had eaten zinc phosphide pellets. Phosphine gas was produced when the pellets reacted with acid and water in the dog's stomach. Clinic staff developed headaches, shortness of breath, nausea, and dizziness after the dogs vomited in the examination room.

Zinc phosphide is used to kill rats, mice, moles, and gophers. It is sold as a dark gray powder or as a pellet. Trade names include Arrex, Commando, Dexol, Kilrat, GophaRid, Phosvin, Ridall, Ratol and Sweeney's Poison Peanuts. The chemical may smell like fish or garlic, but you should not rely on odor as a warning that phosphine is in the air. It may at toxic levels before you notice an odor.

The following information is important for veterinarians and pet owners to avoid becoming sick while providing treatment to pets that have eaten zinc phosphide powder or pellets.

- Check to see if the dog has eaten a product that contains zinc phosphide.
- If the product does contain zinc phosphide, have the dog vomit outdoors, where there is plenty of air and the area can be hosed down with water.
- Stand upwind of the dog.
- Do not lower your head down to the dog. Phosphine is heavier then air and will sink to the ground.
- After the dog has finished vomiting, move it away from the vomit.
- Hose down the area with lots of water while standing upwind of the vomit. It can be washed down a storm sewer or off a hard surface onto grass. There will be enough air movement outdoors to prevent the phosphine from reaching levels that can harm humans or pets.
- Make sure the vomit is diluted enough so it does not attract other dogs or animals. The poison in any remaining pellets in the vomit will be released by the water, making them non-toxic.

If the dog vomits indoors:

- If the dog vomits indoors, the phosphine gas may reach levels that could be harmful to people. Remove people and pets from the area and open doors and windows to ventilate the area.
- Run a fan at floor level. The gas is heavier than air and will sink to the floor. Running the fan will help move the gas out of the area.
- Call 911 to reach your local fire department. Most fire departments can determine whether or not the air is safe.
- Exposure to phosphine gas can cause:
    - Headaches
    - Nausea, diarrhea, stomach pain, and vomiting
    - Chest tightness, difficulty breathing, and soreness or pain in the chest
    - Dizziness and staggering

  If anyone has these symptoms after exposure to the dog vomit, have them get medical attention right away.

For more information, contact your Poison Control Center at (800) 222-1222 or go to the Agency for Toxic Substances Disease Registry web site, http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=214.

April 28, 2010